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hereby certify that to the best of my knowledge and belief the following is a true translation made by me of the text of International Patent Application PCT/EP03/04465

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Dated this 26th **day of** August **2004**

Translation
International Patent Application No. PCT/EP03/04465

Signal analyser and method for displaying the power of code channels

The invention relates to a signal analyser and a method for displaying the power of code channels of a CDMA (Code Division Multiple Access) signal.

In the context of checking the components of mobile telephone systems of the third generation, it is necessary to determine the power of the individual code channels, of which the overall signal is made up. The relevant powers of the code channels are presented graphically to evaluate the measured powers of the individual code channels. A graphic presentation of this kind of the powers of individual code channels is disclosed, for example, in US 6, 219, 340 B1.

According to US 6, 219, 340 B1, the individual powers of the relevant active code channels are presented in the form of a bar diagram. In this diagram, the individual channels, are plotted along the X-axis, in such a manner that the code channels belonging to each code class are arranged adjacent to one another. The power measured for each code channel is shown by the height of the bar. The membership of the individual code channels in a given code class, that is to say, their association with a given spreading factor (SF), is shown, in the presentation proposed, in that, corresponding to the lower spreading factor in the lower code class, the bar allocated in the presentation is wider for the corresponding code channel of the lower code class.

Moreover, US 6, 219, 340 B1 proposes that inactive code channels are indicated in the presentation by a dash. In this context, inactive channels are understood to be all code channels, which do not contribute to the data transmission.

The presentation of a measured CDMA signal proposed in US 6, 219, 340 B1 has the disadvantage, that it is not possible to distinguish whether a code channel in a code class is actually active, or whether the code channel is inactive, but the power of a corresponding code channel of a higher spreading factor is measurable there. A lack of discrimination of this kind between an actual power of an active code channel and a so-called alias power of an inactive code channel in a code class, which is lower than the actual code class of the active code channel, considerably impairs the evaluation of the overall CDMA signal.

The object of the invention is to create a signal analyser and a method for displaying the code-channel powers of a CDMA signal, wherein a distinction can be made between a power, which actually originates from an active code channel, and an alias power. This object is achieved by the method according to the invention as defined in claim 1 and the signal analyser as defined in claim 7.

According to the method of the invention, those code channels relating to a given basic spreading factor which are inactive, but for which a so called alias power occurs, are specially marked in a diagram, which presents the powers occurring in the individual code channels. In evaluating the individual powers of the code channels, it

is therefor[redacted]ossible to distinguish si[redacted] between actually active code channels and code channels, which are inactive in the given basic spreading factor. This distinction is also possible, if the actually inactive channels show a measurable power in the form of an alias power.

Advantageous further developments of the method according to the invention and the signal analyser according to the invention can be achieved using the measures specified in the dependent claims.

In particular, it is advantageous to select a bar diagram for the presentation of the power of the individual code channels, and to present those bars of the code channels, in which an alias power is measurable, in a different colour. With this colour marking, it is possible to infer simply from the diagram which code channels provide an alias power, which actually originates from code channels of a higher code class. In this way, the information regarding the level of the power actually measured is retained.

Moreover, it is particularly advantageous, in the event of an occurrence of an alias power of this kind, to switch automatically, in response to an entry by an operator, to the presentation of that code class, which contains the code channels causing the alias power. Starting from a presentation of the code class with the basic spreading factor, the operator can then immediately recognise the code class, from which the alias power occurring in a lower code class actually originates. A further simplification is possible if, when switching to a presentation with a higher spreading factor, the code

channel, which shows an alias power, is marked with a marking device, which is allocated to the corresponding code channel causing the alias power.

With another marking, for example, a differently coloured marking, it is also possible, when using several antennae of the same transmission unit, to which mutually orthogonal codes are allocated, to distinguish whether the alias power originates from a signal of the same antenna or from a code channel of the other antenna. The use of different markings for code channels, which provide alias powers of different origins, allows the corresponding causes for the alias power to be distinguished in a simple manner.

One preferred exemplary embodiment of the invention is presented in the drawings and explained in greater detail below. The drawings are as follows:

Figure 1 shows a schematic presentation of the occurrence of an alias power;

Figure 2 shows a presentation of measured powers of code channels with an alias power for a basic spreading factor;

Figure 3 shows a presentation of the powers of the code channels from Figure 2 for a higher spreading factor;

Figure 4 shows a schematic presentation of the occurrence of an alias power through the use of two antennae;

Figure 5 shows a presentation of the powers of the code channels for a basic spreading factor in a bar diagram;

Figure 6 shows a presentation of the powers of the code channels from Figure 5 for a higher spreading factor;

Figure 7 shows a further schematic presentation of the occurrence of an alias power and

Figure 8 shows a block circuit diagram of a signal analyser according to the invention.

With a mobile telephone system of the third generation, a base station communicates with several mobile devices, the various mobile stations transmitting information simultaneously to the base station and vice versa. The individual signals sent to or from the mobile stations are distinguished by allocating corresponding codes to the subscribers, the corresponding codes being mutually orthogonal. The number of items of information to be transmitted per unit of time can be varied in dependence upon the spreading factor SF, upon which the code is based. To exploit the transmission capacity to the maximum, the signal actually received and/or transmitted by the base station consists of code channels, which provide different spreading factors.

Each code of a given spreading factor branches again in the plane of the next higher spreading factor into two orthogonal codes. Figure 1 illustrates this by way of example for the code 4 with a spreading factor 64 (reference C4). In the next higher code class, that is,

with a spr[redacted]ing factor 128, the code 4[redacted] subdivided into a code 4 with spreading factor 128 (reference C4') and a code 68 with the spreading factor 128 (reference C68). Figure 1 shows a detail of a code tree diagram with three code classes with the spreading factors 64, 128 and 256 respectively.

The code 32 relating to spreading factor 64 (C32), shown schematically in Figure 1 with dark shading, and code 68 relating to spreading factor 128 (C68) are active. When measuring the signal with the assistance of a signal analyser, which presents each measured power of the code channels relating to the spreading factor 64, the power of the active code channel 32 is presented with an additional power for the code channel 4. In this context, the power of the code channel 4 is a so-called alias power, which also occurs with an inactive code channel 4 and originates from an actually active code channel 68 of the spreading factor 128. The code channel 4 of the spreading factor 128, however, is actually inactive. In the diagrams, inactive code channels are represented by empty circles.

Figure 2 shows a presentation of the powers of the individual code channels for the basic spreading factor 64. In this presentation as a bar diagram, the individual code channels are plotted horizontally, so that the height of the bars allocated to the individual code channels indicates the measured power for each code channel. Code channels, which are actually active in the code class presented are marked with the reference 2 in Figure 2 and are presented, for example, in a given colour. The code channels, which are inactive with a basic spreading factor of 64 are preferably presented in

another colour and are shown in Figure 3 by way of example with the reference 3.

As already explained in the context of Figure 1, the code channel C4, which provides an alias power, is labelled with the reference 5 in Figure 2 and is marked in a special manner by the display device 1. For example, with the bar diagram selected in Figure 2, a differently coloured bar may be used for this purpose. Furthermore, a marking 4 is shown in Figure 2, which can be allocated by the operator of the measuring device to any desired code channel. In the example presented, the marking 4 is allocated to the colour-marked code channel C4 (reference 5).

Figure 3 provides a presentation of the measured results, as already shown in Figure 2, for a spreading factor 128, that is to say, for the next higher code class. As already explained in the context of Figure 1, in the presentation relating to the spreading factor 128, an unambiguous distinction must be made between the code channel C68 and the code channel C4'. Accordingly, the display device 1 displays only a slight noise power for the code channel C4' labelled with the reference 5', which is synonymous with the statement that the code C4' is actually inactive. By contrast, a relatively high power is indicated for the code channel C68 labelled with the reference 5'', which means that the code channel C68 is actually active and has therefore caused the alias power of the code channel C4 with spreading factor 64. Since the code channel C68 provides an actual power rather than an alias power, the bar allocated to the code channel C68 is now no longer marked with a special colour. On the contrary, it is shown with the same colour

as all oth[redacted]active code channels relat[redacted] to the spreading factor 128. To make it easier to locate the corresponding code channel, the marking 4 from Figure 2 is set as the marking 4' on the code channel C68 in Figure 3. This displacement of the marking 4, 4' corresponds to the occurrence of the alias power on the basis of the code generation according to the Hadamard matrix.

Other presentations are also possible instead of the preferred presentation in a bar diagram with special colouring of the corresponding code channels, for example, arrow diagrams or line diagrams etc. It is also possible to mark a code channel, which provides an alias power, by other means than colouring. For example, shading, a border arranged around the bar, a flashing bar or arrow may be considered.

Figure 4 presents a further possibility for the occurrence of the alias power, as it arises in transmission units with two antennae, wherein the antennae each use codes, which are mutually orthogonal (Orthogonal Transmit Diversity OTD)). In this context, the channels of a first antenna ANT1 and a second antenna ANT2 are each spread with an additional orthogonal spreading factor. This means that the code channels are actually disposed in a plane of the code tree diagram with a doubled spreading factor.

In Figure 4, this is shown by way of example for the code channel 16 of antenna ANT1 with spreading factor 64. As indicated by the empty circle, the code channel C16' of the antenna ANT1 with spreading factor 128 and Orthogonal Transmit Diversity is inactive. The code channel C144

(Code 16, [redacted]enna ANT2, spreading fact[redacted]SF128 with OTD), however, is active. Accordingly, the power of the code channel C144 is measured as the alias power of the code channel C16 (Code 16, antenna ANT1, spreading factor SF64 with OTD). A corresponding presentation on a display device 1 is again shown in Figure 5, for a basic spreading factor 64. The only-apparently-active code channel C16 is labelled in Figure 5 with reference 6 and highlighted by the use of another colour in the bar diagram. The marker 7, allocated in Figure 5 to the code channel C16, is again, in the presentation relating to the spreading factor 128 shown in Figure 6, allocated to the code channel C16', which does not now provide an alias power and is accordingly shown as inactive. In the presentation shown, all code channels belonging to the antenna ANT1 are presented in such a manner that the code channel causing the alias power is not recognisable.

Figure 7 shows, by way of example, the occurrence of an alias power through the active code channels of a higher code class and simultaneous use of Orthogonal Transmit Diversity. In code channel 18 in this diagram (Code 18, antenna ANT1, spreading factor SF64 with OTD), a power with the next higher spreading factor, which originates from code channel 18 of the next code class (antenna ANT1, spreading factor SF128) with Orthogonal Transmit Diversity, can be identified, and also a power, which originates from code channel 18 of antenna ANT2 with spreading factor 128 with OTD. Both powers are mapped in the code channel C18 of the antenna ANT1 with spreading factor SF64 with Orthogonal Transmit Diversity and accordingly marked in colour in a diagram, which presents the power distribution of the individual code channels, wherein the marking corresponds, preferably in dependence

upon the application, either to the marking of alias powers of a higher code class or of alias powers through OTD.

Figure 8 shows a schematic presentation of a signal analyser according to the invention. The signal analyser 10 according to the invention has an input connection 11, to which a CDMA signal 12 to be measured is connected. The input connection may be either an antenna connection for the antenna 18 or a connection for a signal line. The incoming signal 12 is supplied from the input connection 11 to an analysis device 13. In the analysis device 13, the incoming CDMA signal is analysed, so that the actual power is determined for all active code channels and accordingly, the active code channels can be allocated to the code classes. To display the measured power of the individual code channels on a display device 14, an entry is implemented by the operator in an operating field 15, which is supplied via a connection 16 to the analysis device. The presentation parameters entered in the operating field 15 contain, for example, the selection of given basic spreading factors for the display.

The powers of the code channels to be presented for a given basic spreading factor are communicated by the analysis device 13 via a further connecting line 17 to the display device 14, on which, once again, the measured powers of the individual code channels are displayed in a presentation corresponding to the presentation from Figure 2, Figure 3, Figure 5 and/or Figure 6.

If the operator recognises, on the basis of the colour presentation of code channels, that a code channel provides an alias power, he can make an entry via the

operating field 15, in response to which the analysis device 13 communicates to the display device 14 the information required for a modified presentation of a higher code class with the corresponding higher spreading factor SF. A presentation relating to the smallest spreading factor, for which no alias power occurs in the code channels, can also be selected automatically. The presentation for a given spreading factor can also be selected directly via the entry, instead of an automatic switching of the presentation relating to a spreading factor.

Furthermore, Figure 8 illustrates the case, in which a transmitter 19 transmits via two generally spatially offset antennae ANT1 and ANT2, wherein the codes used are spread into the next higher code class, as described above.

Claims

1. Method for displaying the powers of code channels of a CDMA (Code Division Multiple Access) signal, which contains code channels (C4, C32, C68, C16, C144) with different spreading factors (SF64, SF128, SF256), comprising the following procedural stages:
- reception of the CDMA signal;
- measurement of the power of the individual code channels (C4, C32, C68, C16) of the CDMA signal received;
- presentation of the measured powers of the individual code channels for a given basic spreading factor in a diagram (1); and
- marking of those code channels (5, 6), which provide an alias power, wherein a code channel (C4, C16, C18) provides an alias power relating to the given basic spreading factor, if the code channel (C4, C16) with the basic spreading factor (SF64, SF128) is inactive, and a code channel (C68, C144) of a higher spreading factor (SF128, SF256) corresponding to it is active.

2 Method according to claim 1,
characterised in that,
the powers of the code channels are displayed in a bar diagram.

3. Method according to claim 1 or 2,
characterised in that
those code channels (5,6), which provide an alias power, are marked in colour.

4. Method according to any one of claims 1 to 3, **characterised in that**
the powers of the code channels are displayed automatically after a user entry, with the highest spreading factor (SF128), which contains an active code channel (C68).

5. Method according to any one of claims 1 to 4, **characterised in that,**
in the case of a change to a higher spreading factor (SF128), a marking (4), which is allocated to a code channel (5), which provides an alias power, is assigned to the code channel (5'') causing the alias power.

6. Method according to any one of claims 1 to 5, **characterised in that**
when measuring a CDMA signal from a transmitter with a first antenna (ANT1) and a second antenna (ANT2), which use mutually orthogonal codes, a code channel (6) with the basic spreading factor (SF64) of the first antenna (ANT1), in which an alias power occurs, which is an actual power of an active code channel (C144) of the second antenna (ANT2), is marked differently from a code channel (5) with an alias power, which is an actual power of a code channel (5'') with a higher spreading factor (SF128) of the same antenna (ANT1).

7. Signal analyser (10) for measuring powers of code channels of a CDMA (Code Division Multiple Access) signal, comprising an analysis device (13) for evaluating the power of the individual code channels (C4, C32, C16, C18, C144) and a display

devic[redacted]14) for visual presentati[redacted]f the powers of the individual code channels of a given basic spreading factor in a diagram (1),
characterised in that
those code channels (C4, C16) relating to the given basic spreading factor (SF64), which are inactive and for which an alias power is measurable, are marked in the diagram (1), an alias power being present, if a code channel (C68) of a higher spreading factor (SF128), which corresponds to an inactive code channel (C4) relating to a given basic spreading factor (SF64), is active.

8. Signal analyser according to claim 7,
characterised in that
the power of the code channels is presented in a bar diagram.

9. Signal analyser according to claim 7 or 8,
characterised in that
the inactive code channels (C4, C16) of the given basic spreading factor (SF64), for which an alias power is measurable, are marked in the diagram (1) in a different colour from the active code channels (2) of the given basic spreading factor (SF64).

10. Signal analyser according to any one of claims 7 to 9,
characterised in that
the code channels relating to the maximum spreading factor (SF128), which contains an active code channel (C68), are automatically presented on the display device (14).

11. Signa[redacted]nalyser according to any [redacted] of claims 7 to 10,

characterised in that

in analysing a CDMA signal of a transmitter with a first antenna (ANT1) and a second antenna (ANT2), which use mutually orthogonal codes, those code channels (16) of an antenna (ANT1), for which an alias power is measurable, which is caused by an active code channel (144) of the other antenna (ANT2), are presented differently from code channels (4) with a measurable alias power, which is caused by an active code channel (68) of a higher spreading factor (SF128) of the same antenna.